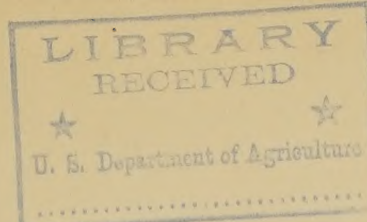


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USE OF ILLUSTRATIVE MATERIAL IN SECONDARY AGRICULTURAL SCHOOLS.

INTRODUCTION.

Teachers of agriculture are beginning to realize that if the subject is to be given a permanent place in the curriculum it must be something more than a study of books. In the attempt to make the work more practical emphasis is being placed upon laboratory exercises and home projects. In connection with such practical work, there is need for more attention to stimulate interest in the recitation and a closer linking of the work of the classroom with the practical work. Inasmuch as a proper use of illustrative material will do much toward arousing interest and making the subject of agriculture a more vital one, the following suggestions are given concerning the value and use of such material:

IMPORTANCE OF VISUAL INSTRUCTION.

Concrete material v. abstractions.—In a class which was considering the relation of water to the soil a teacher took up the greater part of the recitation period in discussing capillarity. As the discussion was somewhat technical, it seemed difficult for the students to understand how water moved upward in the soil. Some of the students showed plainly a lack of interest. In another class, which was considering the same subject, the teacher started out by dipping the bottom of a cube of sugar in some water which was colored with ink. Although the students did not understand why the water moved upward, it was plain that there was an upward movement and that when it reached some pulverized sugar which was placed on the top of the cube its movement was checked. Through this simple demonstration their interest was aroused and the way opened for a very interesting discussion of the movement of water and its conservation by means of a mulch. This class work, reinforced in the laboratory by work with soils of different types in which the water moved upward in glass tubes, led to practical knowledge of an important phase of soil physics.

It is a fundamental rule of pedagogy that we should go from the concrete to the abstract and from that which is more familiar to that which is less familiar. Too often this basic principle is ignored or lost sight of entirely in the teaching of agriculture. Possibly it is because the science of agriculture is based upon the older sciences which have been worked out to a great

extent in an abstract way that we lose sight of the fact that agriculture deals largely with the common things about us.

Relation to interest.—The interests of students are connected with things about them and with new knowledge concerning those things. Modern educators aim to relieve school work of drudgery by connecting their instruction as far as possible with the natural interests of their students. Teachers will do well to remember the interest of students in tangible things and in processes in which action is involved. If this is kept in mind teachers will be appreciative of the value of illustrative material in arousing interest and will develop judgment in its choice.

The eye-minded student.—Another important fact to keep in mind is that all students learn largely through what they see. Some students are especially dependent upon their eyes for obtaining impressions. We speak of such students as being eye-minded. Teachers should study their students as individuals and learn how best to reach them. In most cases students hear too much and see too little. The eye-minded student has little chance. There are few teachers who may not profitably spend more time in visualizing the student and in a wider use of concrete material.

THE FIELD TRIP.

Field practicums.—The term "practicum" is being used in a very broad way with reference to school work. The term should be used with reference only to such laboratory or field work as affords actual practice for the student or exercises in which the student actually participates. Progressive teachers utilize the surrounding farms for practice in such work as spraying and pruning of trees, judging of live stock, and laying of drain tile. Although such work is a very important part of modern agricultural instruction it does not form a part of our present discussion.

Observation trips.—It is often desirable to make trips for the purpose of merely studying agricultural materials and methods without the students taking part except to observe and take notes upon what they see and hear. If it is convenient, a lesson in the field may be more profitable in connection with a study of crops than a classroom recitation. Methods of cultivation may be studied as well as the growing plants. Materials may be gathered and observations made which will furnish a basis for future study and discussion in the classroom. Students in animal husbandry may very well visit near-by stock farms where good types of animals or good methods of care and feeding are to be observed. Visits to creameries, canning factories, sugar factories, packing houses, city markets, and other industrial centers closely related to farm work may be made well worth while. Classes considering farm mechanics may visit implement houses to study farm machinery or a farm where some new machine is in operation. Likewise the erection of farm buildings, the installation of water systems, and other such constructive work will be of interest to students of rural engineering. Agricultural fairs and exhibits offer opportunities for trips of such educational value that the teacher of agriculture can not afford to overlook them.

Field trips often fail through lack of proper training and management. For each trip there should be a definite aim and the object of the trip should be kept well in mind by teacher and students. A definite outline will prove helpful in keeping before the students the aim of the trip. Although the formal discipline of the classroom has no place in such a trip, the students should not be allowed to forget that they are out for purposes of instruction, and that the trip is a part of their school work. If a written report or an oral discussion of the trip is required, it will often aid in securing closer attention to details as well as afford an opportunity to go into the subject at greater length. The taking of notes is often advisable as an aid to such a report or discussion. In many cases it will facilitate the management of the trip if the teacher will go over the ground before the trip and make all necessary arrangements and plans.

ILLUSTRATIVE MATERIAL IN THE CLASSROOM.

Fresh material.—It is often more convenient to study agricultural materials in the classroom than in the field, and, as suggested in the preceding topic, a classroom consideration of materials is often profitable in connection with a field trip. The class may go into the field to study methods of handling a certain crop, but a more detailed study of the plant may be made in the classroom. It is not always possible, if desirable, to go into the field, so the teacher should appreciate the value of bringing material into the school for both classroom and laboratory use. Inasmuch as agriculture deals largely with plants, animals, and the soil, there is an abundance of material which may be drawn upon. This material when alive or in a fresh state has an advantage over dry or mounted material in holding interest and in bringing out details of structure and function. It is often the case that the material does not permit of preservation in such a state that it is useful for study. Teachers should take advantage of fresh material when it can be obtained and keep in mind the chances for obtaining such material when planning their courses.

In order to supply material suitable for classroom use, some of the schools have used a garden plat or a part of the school farm for the purpose of growing illustrative materials. These gardens serve as a sort of museum of living specimens. In some cases they serve as demonstrations to people of the community of crops which may be suitable for their farms. In the garden of a western school the students planted, among other things, a number of types and varieties of sorghum. As most of the types were new to the community, the garden succeeded in arousing interest in a crop suitable to the section. The garden plat for illustrative material has the advantage in giving the students the opportunity to study the crops while growing, as well as in giving assurance of materials suitable to illustrate the course which may be planned.

Securing fresh and living material out of season is often desirable, but a somewhat difficult problem is presented. The school which owns a greenhouse is fortunate, as it affords a supply of material as well as a place for practice work with plants during the winter months. Breeding cages or terraria for land forms of animals, aquaria for water forms, and window boxes for plants may be used under favorable conditions to supply certain kinds of living material during the entire year.

Mounted material.—It is not always convenient to make use of fresh material. For a great many schools there is a long period in winter when they must make use of material dried or in some manner preserved. Such material as soils, fertilizers, seeds, and animal feeds need no preservation other than protection from dampness, and mice and other pests. Such material may be simply placed in glass jars of uniform size, convenient to handle, or kept in bulk in cabinets or bins. Most plants may be dried and mounted to show type and variety of crops, noxious weeds, effect of insect injury, or plant disease. Insects may be easily mounted on pins or with other small animals preserved in alcohol or formaldehyde.¹

Teachers should have their work planned ahead and be sure that there is an abundance of material for classroom and laboratory use. Certain plant and animal materials may be secured only at definite times, hence the necessity of making an outline or calendar for the gathering of illustrative materials. In one State where the teachers of agriculture are employed for the whole year the gathering of such material is a definite part of their summer work.

Use of the blackboard.—Teachers who appreciate the value of visual instruction make extensive use of the blackboard. All teachers of agriculture should have sufficient training in drawing that they may, with little time and effort, make such simple drawings as outlines of animal and plant types and rough plans of farms and buildings. Many topics may be

¹ For suggestions regarding the collecting and mounting of materials see the following: Collection and Preservation of Plant Material for Use in the Study of Agriculture, U. S. Dept. Agr., Farmers' Bulletin 586 (1914); Collection and Preservation of Insects and Other Material for Use in the Study of Agriculture, U. S. Dept. Agr., Farmers' Bulletin 606 (1914).

effectively diagrammed or otherwise shown in a graphic way. Formulas and statements involving figures are more impressive if placed on the blackboard before the students. Often the main points or a summary of the lesson is written on the board in terse terms that the students may grasp the thought in a better way. Sometimes an outline of a special topic or even an outline of the whole lesson may be profitably placed on the board by teacher or students. Some very successful teachers have the reputation of "talking with chalk," which means that the oral statements of the class are reinforced or supplemented with illustrations or statements on the blackboard. With such teachers both the eye-minded and the ear-minded students have an opportunity. It is well to leave a good deal of the blackboard work to the students, so that they may profit by doing as well as seeing.

Charts and maps.—Many of the illustrations, outlines, and diagrams which are used on the blackboard may have such value that they should be preserved in a more permanent form as charts. These charts may be made of heavy manila paper or of cloth and mounted upon rollers. A rubber stamping outfit will be found useful in the making of these charts. The more simple the diagram and the more brief and terse the statements the more impressive will be the chart. Many useful printed charts may be obtained, some of them colored attractively. The extension departments of some of the colleges are getting out poster bulletins on timely subjects, which are useful for what they represent and what they should suggest to the teacher. A supply of maps of local and wider areas is usually to be found with school equipment. These, with outline maps, may often be used with profit. Pins with colored heads may be secured from supply houses and used upon maps to show centers of production and other statistical data. In one school the students made topographical maps of the neighborhood of papier-mâché, which showed the layout of their individual farms.

How to use a soil survey map.—A great many soil surveys have been made in the United States and many of the schools are in areas where soil maps are available. The first thing to study is the scale; what the scale is, and what it means. The scale is given at the bottom of the map. Usually 1 inch represents a mile. Let the students measure the distance between two roads or between their house and the road about a mile away, or a bend in the road, measuring it on the map in inches and in the field in feet. Give them the number of feet to the mile and let them check up the distance on the map and on the field.

The next thing is direction. Soil maps are always drawn so that the upper edge is toward the north, and everything is drawn from this position. If there is a compass in the schoolhouse, put it on the map and turn the map until the edge of the map is exactly in the direction of the compass needle. Make all observations with the map in this position. If there is no compass get a distinct object, such as a crossroads, church, or house, and place the map so that the direction from the school to the object on the map is in line with the object in the field. Always make observations on the map with the map in this position. Measure the distance along this line from the schoolhouse to a point in the road. Carry the map to that point, fix it in the original position, and see if the turn in the road corresponds to the way it is drawn on the map. This gives an idea both of distance and direction as platted on the map to represent actual conditions in the field.

Differences of soils should be noted. The soils around the school are recognized by name as representing a soil type. Some distance away from the school in a certain relation to roads or houses a different type of soil is recorded on the map. One may be a sand and the other a clay soil. The descriptions of each are given in the report. Have the children visit those two sections and compare the soils.

The report states that a sand may be adapted to certain crops and not to other crops which the clay soil is adapted to. See that a sand is not so retentive of moisture; that it does not keep as moist as the clay soil. If these two soils are examined during wet periods and during

dry periods, the differences in the moisture content and their relation to moisture can be made apparent to the children, and they can be brought to see that these differences frequently influence vegetation so as to make one soil adapted to one crop and another soil to another crop.

Explain the purpose of the soil map as giving a minute representation of actual soil differences. Show how this differs from an ordinary geological map, where colors are used to convey different meanings. Show why it is that different symbols are used for county or township boundaries, for roads, for railroads, for villages, and for houses so that at a glance they can see what these physical features are by the form of the symbol used. Indicate that certain colored soils always run along the stream channels; others are only found on the higher ridges; that the form of the surface and the way the soil has been deposited has much to do with the distribution of the soils of the county.

Pictures.—Paintings, photographs, and printed pictures pertaining to agricultural subjects, when hung upon the wall will aid in giving the classroom an agricultural atmosphere. In connection with studying types and breeds of farm animals, farm buildings, and many other subjects, mounted pictures are often a great aid. Many of the farm papers have illustrations which may be used for this purpose. If files are not kept of the papers, the good pictures may be clipped and mounted on cardboard for future class use.

Stereopticon.—A good projection lantern will be found invaluable for class work as well as extension work in agriculture. Slides may be of such material as may be shown in charts or mounted pictures. They will be found effective in showing types and breeds of farm animals, in contrasting the good and bad in farm life, farming methods, and all farm products. There is little pertaining to farming that can not be effectively illustrated with lantern slides. If their is not a special lecture room for the use of the lantern, the classroom should be equipped with such shades that it may be darkened. Original pictures and slides have the most value to a teacher, yet good use may be made of material prepared by others.¹

Use of a camera.—In order to have original material and to keep an interesting record of work done, every teacher of agriculture should have a camera and know how to use it. An inexpensive one will be satisfactory for most work. It need not be large. In taking pictures the teacher should remember that they are to be used for educational purposes, and bear well in mind the particular thing he wishes to illustrate. Accurate notes should be made in connection with each photograph so that it may have full value in future times and when used by others. If the teacher has not proper facilities for developing, printing, and the making of lantern slides, this work may be done by experts at a nominal cost.

Filing and indexing.—Provision should be made for the proper filing and indexing of all negatives, prints, slides, and other such material. Simple letter files or large manila envelopes with an index list and key may be suitable for pictures or film negatives. Filing cabinets may be made or purchased with drawers of suitable size for slides or glass negatives.

THE AGRICULTURAL MUSEUM.

If future needs are kept in mind permanent collections will be made of plants of all kinds, insects, and other small animals, rocks, minerals, soils, fertilizers, seeds, and various plant and animal products. Educational exhibits of the last-mentioned materials are often furnished free of charge by manufacturers.

Some of the colleges and laboratory supply houses furnish agricultural exhibits at a nominal cost. It should be borne in mind that a great deal of interest will be aroused and much will be learned by the students in collecting material. The teacher should not fail to take advantage

¹ Sets of lantern slides on various phases of agriculture and agricultural education have been prepared by the Division of Agricultural Instruction in Schools of the U. S. Department of Agriculture. A list of slides with instructions as to how they may be obtained may be had upon application.

of the collecting instinct of his students. In time an agricultural museum will be established which will not be a repository for curiosities, but a collection of materials useful in teaching. Time is often wasted and valuable material lost because proper provision is not made for taking care of collections. The students may have the making of cabinets and cases as a part of their manual training or farm mechanics work. Special attention should be given to protection from such pests as mice and moths.

WEEDS AS A SUBJECT OF INSTRUCTION IN SECONDARY SCHOOLS.

INTRODUCTION.

It has been estimated that weeds are the cause of losses to the farmers of the United States amounting to \$300,000,000 per year. No one will question the importance of a study of weeds in a course in agriculture. The control of weeds is so important in practical farming that crop production is considered by many to be largely a battle against weeds. It is the aim of this paper to give suggestions that will aid teachers in their training of future farmers that they may have greater chances of victory in their battle against these pests.

PLACE OF THE SUBJECT IN THE CURRICULUM.

Foundation in plant study.—A study of weeds, like a study of crops, should be based upon a knowledge of how plants grow. Students who have had a practical course in botany have a great advantage in a study of the plant side of agriculture. When students have no preparation in botany it is necessary to bring out the essentials of plant behavior in an introductory course in agriculture. Usually general lessons pertaining to plant growth are given preliminary to a consideration of crops. A study of weeds affords a good opportunity to apply the general principles learned or to develop them in case they have not been considered before. A knowledge of plant associations, methods of propagation, and seed dispersal are especially important.

Weeds in the course in crop production.—It is not possible to treat fully the production of crops without considering the control of weeds. As different classes of crops are troubled with different pests, and as different methods of control must be employed in connection with the production of various crops, it is necessary to consider weeds in a special way with each group of crops; thus we may consider weeds of the grain field, weeds of the pasture, or weeds of the orchard. With some crops the control of weeds must be given special emphasis, as it may be the most important factor in the production of the crop.

Weeds in the course in animal husbandry.—Inasmuch as some weeds are poisonous to animals and others are otherwise injurious to animals or their products, it becomes necessary to consider weeds in connection with courses in veterinary science, animal production, and dairying.

Weeds in the course in farm management.—The control of weeds may affect the planning and management of the farm as a whole. It may influence the selection and rotation of crops, and even the choice of the farm itself, hence it is a subject to be considered in the course in farm management. In this course the economy of weed control should be considered in a general way.

Weeds as a separate subject.—Although the subject of weeds may enter into a consideration of the various phases of farming mentioned above, it will be found profitable to consider weeds in a general way as a separate subject. The amount of time given to the subject will depend upon the total time devoted to agriculture. In general courses of one year perhaps three days will be all the time available, while in a special course in crop production a week or more may be devoted to the work. The lessons should be adapted to the needs of the community as well as to the time available and the preparation of the student.

A STUDY OF WEEDS.

Use of illustrative material.—There is little excuse for a study of weeds being merely a study of books. It is always an easy matter to secure an abundance of illustrative material. If the topic is discussed in the fall or spring, the teacher may bring weeds to the classroom and encourage students to do so. Field trips, if arranged with a definite purpose, are always profitable in plant study. Plants may be gathered in the growing season and preserved for winter study or any future use. Collections of weed seeds and farm seeds containing seeds of weeds as impurities should be made for future use and form a part of a permanent museum collection. Charts showing tersely the nature and control of weeds will be found an aid in visualizing the lesson. Well-illustrated manuals will be very helpful in the identification of weeds.

What is a weed?—While no definition which has been given for a weed is entirely satisfactory, the well-known statement that a weed is a plant out of place has the advantage of being terse and easily comprehended. It should be explained that a weed is really a plant which insists on growing where it is not wanted. Some cultivated plants may become pernicious weeds when they get beyond the control of the farmer. An example of such a plant is Johnson grass, well known to farmers of the South. Many weeds are useful for certain purposes; for instance, dandelions and pokeweeds are used as greens. Sweet clover, although for a long time in many sections considered only as a pest, is now being appreciated as a forage crop in certain regions. This plant as well as many other weeds is valuable as a source of nectar for bees. It should not be difficult to give students an understanding that plants which intrude and offer difficulties in control are considered weeds although they may be useful under other conditions.

Why have weeds become harmful?—The characteristics which enable plants to become weeds furnish interesting topics in a study of adaptation and struggle for existence among plants. Among the reasons why plants have adapted themselves to farm conditions to the extent that they have become weeds are that they may have the advantage—

In number of seeds.

In means of dissemination.

In vitality of seed and time of germination.

In means of asexual propagation.

In means of protection, such as thorns, repulsive odors, disagreeable tastes, and poisonous properties.

In adaptation to soil, climate, and other environmental conditions.

With the aid of reference material these topics may be developed and examples given. Weeds should be selected as far as possible from the local flora to illustrate the advantages mentioned.

In connection with this topic it will be profitable to discuss how the important weeds of the district have been introduced and how they have been spread.

Damage due to weeds.—After discussing the nature of weeds some of the ways in which weeds reduce the profits in farming should be easily comprehended. The following are suggestive topics to be discussed in considering damage done by weeds:

1. They rob crops of plant food and moisture.
2. They rob crops of room and light.
3. They may harbor insects and plant diseases.
4. They increase labor and cost of cultivation and harvesting of crops.
5. They damage the quality of both plant and animal products.
6. They may prove injurious and even fatal to farm animals and even to man.
7. They may interfere with rotation of crops and other phases of farm management.
8. They are, as a rule, unsightly and may decrease the value of land.

Useful properties of weeds.—Under certain conditions weeds may have value as suggested below:

1. They may cover bare land, preventing blowing and leaching.
2. They are often a very important source of humus.
3. They may furnish hay and green forage.

These topics may better be considered in connection with such topics as cover crops, green manures, and forage crops. The students should understand that weeds are very much inferior to certain crops planted for these purposes, and that they may promote shiftlessness by possessing even such slight value.

Identification and classification of weeds.—The extent to which the class should go into classification will depend upon the available time and the preparation of the students. The students should know the characteristics of the important groups of plants. They will find the ability to use a botanical key a great aid in identifying specimens. Few classes in agriculture will have the time needed to go into this phase of the work unless the students have had preparation in a course in botany in which some attention has been given the systematic phase of the subject. An herbarium of identified specimens may be built up gradually which may be used for comparison. Each student may be required to collect, identify, and mount a number of specimens. A good manual covering the local flora will be found indispensable in this work. The general weed manuals will be very useful, as will any publications covering local weeds issued by State institutions. The illustrations are often more helpful than the descriptions.

A study of weed seeds.—Students should become familiar with the seeds of the most common and dangerous of weeds which are likely to be introduced into the region. In connection with a study of the seed of the weeds studied and collected there should be an inspection of forage-plant seed for impurities. A good magnifying glass or hand lens will be found indispensable for many kinds of seeds.

THE CONTROL OF WEEDS.

The relation of control to class.—The following questions are suggestive of the treatment of this topic:

- In agriculture how are weeds commonly grouped?
- Why are weeds classified as annuals, biennials, and perennials?
- Give examples of each class.
- What are winter annuals? Example.
- What means of reproduction does each class of weeds use?
- What relation is there between reproduction and control?
- Why are most pernicious weeds perennials?

Special methods of control may be necessary with the most troublesome weeds. These methods may be considered more properly in connection with the crops affected. The methods of control considered at this time are of a general nature.

Preventing the introduction of weeds.—Why should emphasis be placed upon this means of control? Do the students know common weed seeds? Do they understand how to examine farm seeds when purchased that they may be sure they are not introducing weeds? How about purchased feed and barnyard manure as a source of noxious weed seeds? Do any of the farmers examine thrashing outfits which may bring weed seeds to the farm? In irrigated sections the importance of keeping canal banks clear of weeds should be discussed and in all sections emphasis laid upon keeping roads clean.

Cultivation as a means of control.—Why is cultivation as a means of weed control more important in humid than in arid sections? Why should cultivation be emphasized as a pre-

vention rather than a cure for weed growth? When is the best time to cultivate to prevent weed growth? A study of the efficiency of the various weeders and cultivators may be made at this time, although a more thorough study of this subject should be reserved for the farm mechanics course if such a course is given.

Prevention of seeding.—Why is it not always possible to prevent weeds from getting a start? When weeds have once gotten a start what problem is before the farmer in their control? The following topics are suggested as the more important methods of checking growth:

Cutting.—Its importance along roads, fences, and ditches and in fields after the crop has been harvested. Use of the mower and the hand scythe.

Hand pulling.—Its inefficiency when compared with machinery and tools. Where is it necessary? Use of the spud.

Spraying.—Where is this means of special value? What kind of plants are most effectively controlled? What solutions are usually used? The extent to which the class should go into a study of spraying machinery, materials, and methods will depend upon local needs. The use of oil and corrosive chemicals to kill weeds along paths may be considered at this time.

Use of animals.—Where are sheep and goats of value in the control of weeds? What class of weeds are hogs most useful in controlling? This topic may be considered from the standpoint of weed control without getting into the animal husbandry side of the question.

Burning.—In what cases is burning resorted to in the control of weeds? Why should burning of stubble field be discouraged? Discuss burning in connection with cutting weeds along roads and fences.

Smothering.—What class of weeds are controlled by smothering? What is the most common method of smothering? It may be necessary to distinguish between the term as commonly used in connection with the heavy application of manure or straw and the heavy seeding of a hay or grain crop.

Crop rotation and weed control.—The subject of crop rotation in a general way may be considered under farm management, but its value in weed control may be brought out at this time. In connection with this topic the cultivation of meadows and pastures as a means of controlling certain weeds and the seeding of cultivated fields to grass or a forage crop for the control of other weeds may be discussed.

Weed laws.—The students should become familiar with the laws of their State pertaining to weed control. As the enforcement of such laws depends to a great extent upon public support, teacher and students should exert their influence toward making the community familiar with the law and in favor of its operation. The students and the people of the community should become familiar with whatever work the State may be doing in seed testing and inspection.

SUGGESTIVE PRACTICUMS.

Collection and identification of weeds.—Each student should be requested to collect and identify 10 weeds. It is preferable that these weeds be brought from the home farm and represent the weeds giving most trouble. The student should suggest the best means of control for each weed. Whether the student shall use a botanical key, an illustrated weed manual, or mounted specimens for identification is left to the teacher to be determined by the past training of the students and the available equipment. From the weeds collected specimens may be selected and mounted as a weed herbarium for the agricultural museum.

Collection and identification of weed seeds.—Each student should also be requested to collect and identify the seeds of 10 weeds which are liable to contaminate farm seeds. The chief purpose of this exercise is to make the students familiar with the common weed seeds which

may be found in purchased seed. From the seed collected specimens may be selected and mounted for future use in the agricultural museum.

Testing farm seeds for impurities.—Samples of alfalfa, clover, or timothy seed should be secured from the market and tested for weed-seed impurities according to directions in Farmers' Bulletin 428, Testing Farm Seeds in the Home and in the Rural School. The knowledge gained in the preceding exercise should be used as far as possible in the identification of the weed seeds found. The bulletin has illustrations of weed seeds which will aid in identification.

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